



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, Washington 98101


IN REPLY

REFER TO: OEA-095

April 12, 1999

MEMORANDUM

SUBJECT: Bunker Hill, CLP Metals Analysis, Data Validation
Case: 26799
SDG: MJAF24

FROM:  Laura Castrilli, Chemist
Quality Assurance and Data Unit, OEA

TO: Mary Kay Voytilla, Regional Project Manager
Office of Environmental Cleanup

CC: Bruce Woods, Region 10 CLP TPO
Jim Stefanoff, CH2M Hill

The following is a validation of ICP-AES and mercury analyses of ten total and ten dissolved water samples from the Bunker Hill project. The analyses were performed following the USEPA Contract Laboratory Program Statement of Work for Inorganics Analysis Multi-media, Multi-Concentration, ILM04.0. Analyses were conducted by Sentinel, Inc, of Huntsville, Alabama. This validation was conducted for the following samples:

MJAF24	MJAF27	MJAF30	MJAF33	MJAF36	MJAF39	MJAF42
MJAF25	MJAF28	MJAF31	MJAF34	MJAF37	MJAF40	MJAF43
MJAF26	MJAF29	MJAF32	MJAF35	MJAF38	MJAF41	

Data Qualifications

The following comments refer to the Sentinel Laboratory's performance in meeting quality control specifications outlined in the *CLP Statement of Work (CLP-SOW) for Inorganic Analysis, rev. ILM04.0*. The comments presented herein are based on the information provided for the review.

1.0 Timeliness - Acceptable

The technical (40 CFR part 136) holding time from the date of collection for mercury in water is 28 days. The holding time for the remaining metals in water is 180 days. The samples were collected on 02/10/99. Mercury analyses were completed on 02/17/99. ICP-AES analyses were completed on 03/03/99.

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2.0 Sample Preparation - Acceptable

The samples were prepared for mercury and ICP-AES analyses on 02/16/99.

3.0 Calibrations/Calibration Verifications -

The samples were analyzed for mercury by CVAAS on 02/17/99. Initial calibration included one blank and six standards. The curve was linear with a correlation coefficient greater than 0.995.

The samples were analyzed by ICP-AES on 02/23/99, 02/26/99 (twenty fold dilutions for iron and manganese), 03/01/99 (twenty and one hundred fold dilutions for iron, manganese and/or zinc), 03/02/99 (barium analyses), and 03/03/99 (thousand fold dilutions for zinc). The instrument was standardized according to the analytical method each day of analysis using one blank and a single calibration standard for each element.

All ICP-AES and CVAAS (mercury) calibrations were performed as required and met the acceptance criteria; therefore, no qualification was made on this basis.

Continuing calibration verifications (CCVs) are required before and after sample analysis and after every 10 samples during analysis. Mercury recoveries must be within 80-120%. Other metal recoveries must be within 90-110%. The frequency of analysis of CCVs was met. All ICP-AES and CVAAS (mercury) CCVs (initial and continuing) bracketing reported sample results met the recovery criteria; with the exception of zinc in the fourth continuing calibration verification analysis on 02/23/99 (110.4%, 1250 ug/L true value). The fourth CCV was after samples with very high levels of zinc. It is possible that 'carry over' affected the recovery as the fourth continuing calibration blank had a result of 86.7 ug/L. Since the recovery for zinc was only slightly outside the 90-110% recovery criteria, associated sample results were not qualified based on this CCV result.

4.0 Laboratory Control Samples - Acceptable

Laboratory Control samples are digested and analyzed along with the samples to verify the efficiency of laboratory procedures. All recoveries associated with reported sample results met the acceptance criteria for control samples.

5.0 Blanks -

Procedural blanks were prepared with the samples to show potential contamination from the digestion or analytical procedure. If an analyte was found in the associated blank, the sample results were qualified if the analyte concentration was less than five times the analytical value in the blank.

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Copper and zinc were detected in the preparation blank. Aluminum, antimony, barium, cadmium, calcium, copper, iron, magnesium, manganese, potassium, silver, sodium, and zinc were detected in one or more ICP-AES continuing calibration blanks (CCBs). Aluminum in a CCB had a negative value with an absolute value greater than the detection limit. Based on blank contamination, associated sample results were qualified as follows:

- ◆ aluminum was qualified 'U' in sample MJAF28 and 'UJ' in samples MJAF30, MJAF32, MJAF38, and MJAF40
- ◆ antimony in sample MJAF24 was qualified 'U'
- ◆ barium in samples MJAF35-MJAF37 was qualified 'U'
- ◆ cadmium in sample MJAF27 was qualified 'U'
- ◆ calcium, iron, manganese, and zinc in samples MJAF32 and MJAF42 was qualified 'U'
- ◆ copper in samples MJAF30, MJAF38, MJAF40, and MJAF42 was qualified 'U'
- ◆ magnesium in sample MJAF32 was qualified 'U'
- ◆ potassium in samples MJAF32, MJAF35, and MJAF42 was qualified 'U'
- ◆ sodium in sample MJAF37 was qualified 'U'

All other sample results were greater than five times the associated blank levels (or were already undetected) and were not qualified based on blank contamination.

6.0 ICP-AES Interference Check Sample

The interference check sample (ICS) is analyzed by ICP-AES to verify interelement and background correction factors. Analysis is required at the beginning and end of each sample analysis run and recoveries must be between 80% and 120%. All ICS recoveries associated with reported sample results were within the recovery criterion; with the exception of manganese in one ICS-A sample for 02/23/99 and zinc in one ICS-A sample on 03/03/99. ICS-AB (higher manganese and zinc levels than in the ICS-A samples) recoveries were within 80-120%. Manganese and zinc results were not qualified on the basis of ICS-A recovery as those samples that had interferent levels of iron had manganese and zinc results at or above the ICS-AB levels.

The raw data for a number of samples had interfering levels of iron. Analytes for which iron is an interferent were qualified as follows:

- ◆ Selenium in samples MJAF24-MJAF26, MJAF29, MJAF33-MJAF36, MJAF38, and MJAF43 was qualified 'UJ', estimated detection limit (possible false negative due to high iron) or 'J' estimated (possible low bias) as selenium in the three ICS-A analyses bracketing these samples had negative results with absolute values greater than the detection limit.
- ◆ Vanadium in samples MJAF24-MJAF26, MJAF28, MJAF29, MJAF33-MJAF36, MJAF38, and MJAF43 was qualified 'UJ', estimated detection limit (possible false negatives due to high iron) as vanadium in the

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three ICS-A analyses bracketing these samples had negative results with absolute values greater than the detection limit.

Some of the samples required one or more dilution runs to report zinc, iron, and manganese results within the instrumental linear range. The raw data for all analytes were compared using the available dilutions to see if 1) zinc, iron, and/or manganese levels in the undiluted samples were high enough that interelement corrections may not be sufficient for the analytes that were reported from the undiluted analyses or 2) a pattern of suppression or enhancement was evident.

From this comparative study, the following results were qualified due to suspected interference (analytes already qualified due to interference or due to poor serial dilution results were not qualified again, see section 11 for qualification due to serial dilution):

- ◆ Aluminum, arsenic, beryllium, calcium, cadmium, cobalt, copper, magnesium, manganese, nickel, silver, and sodium were qualified 'J', estimated (unknown bias for copper* and sodium; pattern of suppression/possible low bias for the other analytes) in samples MJAF25 and MJAF35. The bias for sodium is unknown as at first the sodium results went up on the twenty fold dilutions and then the sodium results dropped way down below the un-diluted sodium levels on the one hundred fold dilutions.
- ◆ Silver, calcium, and sodium were qualified 'J', estimated (pattern of enhancement/possible high bias for sodium; pattern of suppression/possible low bias for the other analytes) in sample MJAF26.
- ◆ Aluminum and copper were qualified 'J', estimated (unknown bias for copper*; pattern of suppression/possible low bias for aluminum) in samples MJAF28, MJAF29, MJAF38, and MJAF39.
- ◆ Aluminum, calcium, and copper were qualified 'J', estimated (unknown bias for copper*; pattern of suppression/possible low bias for the other analytes) in sample MJAF31.
- ◆ Aluminum, arsenic, beryllium, calcium, cadmium, cobalt, copper, magnesium, nickel, silver, and sodium were qualified 'J', estimated (unknown bias for copper*; pattern of enhancement/possible high bias for sodium; pattern of suppression/possible low bias for the other analytes) in samples MJAF33 and MJAF43.
- ◆ Calcium and copper were qualified 'J', estimated (unknown bias for copper*; pattern of suppression/possible low bias for calcium) in samples MJAF34 and MJAF41.
- ◆ Copper, nickel, silver, and sodium were qualified 'J', estimated (unknown bias for copper*; pattern of enhancement/possible high bias for sodium; pattern of suppression/possible low bias for the other analytes) in sample MJAF36.

* The bias for copper is unknown as copper results were also qualified due to duplicate precision results.

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7.0 Duplicate Analysis -

Duplicate analyses were done on sample MJAF40. Water duplicate results were within the $\pm 20\%$ Relative Percent Difference (RPD) or \pm CRDL criteria for water results < 5 times the CRDL criteria; with the exception of copper which was outside the \pm CRDL criteria. All copper results were qualified 'J' estimated.

8.0 Field Duplicate Analysis - Not Applicable

Field duplicate analysis for samples in this SDG was not indicated in the field collection documentation.

9.0 Matrix Spike Analysis -

Matrix spike sample analyses are done to provide information about the effect of the sample matrix on digestion and measurement methods. Matrix spike recovery must be within the limits of 75 - 125%.

Matrix spike analyses were done on sample MJAF40. All matrix spike recoveries were within the required QC limits, with the exception of antimony (70% recovery), mercury (64%), and selenium (72%). All antimony, mercury, and selenium results were qualified 'J', estimated (possible low bias).

10.0 Graphite Furnace Atomic Absorption Spec (GFAAS) QC - Not Applicable -

GFAAS was not used for the analysis of these samples.

11.0 ICP-AES Serial Dilution -

Sample MJAF40 was analyzed by ICP-AES serial dilution to check for potential interferences. All analytes which exceeded the minimum concentration criterion (50 times the IDL) agreed within the 10%D criteria; with the exception of barium (83%), lead (11.3%), and potassium (12.6%). All barium, lead, and potassium results were qualified 'J', estimated due to serial dilution results.

12.0 Detection Limits - Acceptable

Sample results which fall below the instrument detection limit (IDL) are assigned the value of the instrument detection limit and the 'U' qualifier is attached. Contract Required Detection Limit (CRDL) standards are required to demonstrate a linear calibration curve near the CRDL. CRDL standards were run at the required frequency.

13.0 Overall Assessment of the Data

This validation of the data is based on the criteria outlined in the *National Functional Guidelines for Inorganic Data Review (02/94)*. Approximately 69.6% of the data was qualified based on blank

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contamination, interference, matrix spike recovery, duplicate precision or poor serial dilution results. The data as qualified is acceptable for all purposes.

Below are the definitions for the National Functional Guidelines for Inorganic Data Review (02/94) qualifiers used when validating/qualifying data from Inorganic analysis.

DATA QUALIFIERS

- U - The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.
- J - The associated value is an estimated quantity.
- R - The data are unusable. (Note: Analyte may or may not be present.)
- UJ - The material was analyzed for, but was not detected. The associated value is an estimate and may be inaccurate or imprecise.

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAF24

Lab Name: SENTINEL, INC.

Contract: 68-D6-0001

Lab Code: SENTIN

Case No.: 26799

SAS No.:

SDG No.: MJAF24

Matrix (soil/water): WATER

Lab Sample ID: 18143S

Level (low/med): LOW

Date Received: 02/11/99

% Solids:

0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No..	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	7460	-		P
7440-36-0	Antimony	6.6	B	NJ	P
7440-38-2	Arsenic	207			P
7440-39-3	Barium	13.1	B	EJ	P
7440-41-7	Beryllium	3.0	B		P
7440-43-9	Cadmium	504			P
7440-70-2	Calcium	36400			P
7440-47-3	Chromium	2.8	B		P
7440-48-4	Cobalt	146			P
7440-50-8	Copper	510		*J	P
7439-89-6	Iron	270000			P
7439-92-1	Lead	355		EJ	P
7439-95-4	Magnesium	73800			P
7439-96-5	Manganese	61900			P
7439-97-6	Mercury	0.10	U	NJ	CV
7440-02-0	Nickel	135			P
7440-09-7	Potassium	1150	B	EJ	P
7782-49-2	Selenium	9.5		NJ	P
7440-22-4	Silver	20.2			P
7440-23-5	Sodium	4410	B		P
7440-28-0	Thallium	17.8			P
7440-62-2	Vanadium	1.4	U	J	P
7440-66-6	Zinc	244000			P
	Cyanide				NR

MC 04/09/99

Color Before: COLORLESS

Clarity Before: CLEAR

Texture:

Color After: COLORLESS

Clarity After: CLEAR

Artifacts:

Comments:

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAF25

Lab Name: SENTINEL, INC.

Contract: 68-D6-0001

Lab Code: SENTIN

Case No.: 26799

SAS No.:

SDG No.: MJAF24

Matrix (soil/water): WATER

Lab Sample ID: 18144S

Level (low/med): LOW

Date Received: 02/11/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	170000		J	P
7440-36-0	Antimony	150		#J	P
7440-38-2	Arsenic	5500		J	P
7440-39-3	Barium	15.2	B	EJ	P
7440-41-7	Beryllium	31.7		J	P
7440-43-9	Cadmium	7460		J	P
7440-70-2	Calcium	136000		J	P
7440-47-3	Chromium	15.1			P
7440-48-4	Cobalt	2320		J	P
7440-50-8	Copper	8150		*J	P
7439-89-6	Iron	12300000			P
7439-92-1	Lead	112		EJ	P
7439-95-4	Magnesium	374000		J	P
7439-96-5	Manganese	30700		J	P
7439-97-6	Mercury	0.10	U	NJ	CV
7440-02-0	Nickel	1950		J	P
7440-09-7	Potassium	130	B	EJ	P
7782-49-2	Selenium	3.1	U	NJ	P
7440-22-4	Silver	0.70	U	J	P
7440-23-5	Sodium	320000		J	P
7440-28-0	Thallium	201			P
7440-62-2	Vanadium	1.4	U	J	P
7440-66-6	Zinc	16600000			P
	Cyanide				NR

Color Before: COLORLESS

Clarity Before: CLEAR

Texture:

Color After: COLORLESS

Clarity After: CLEAR

Artifacts:

Comments:

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAF26

Lab Name: SENTINEL, INC.

Contract: 68-D6-0001

Lab Code: SENTIN

Case No.: 26799

SAS No.:

SDG No.: MJAF24

Matrix (soil/water): WATER

Lab Sample ID: 18145S

Level (low/med): LOW

Date Received: 02/11/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	21000	-		P
7440-36-0	Antimony	25.6	B	NJ	P
7440-38-2	Arsenic	810			P
7440-39-3	Barium	9.1	B	EJ	P
7440-41-7	Beryllium	8.0			P
7440-43-9	Cadmium	2060			P
7440-70-2	Calcium	48100		J	P
7440-47-3	Chromium	3.7	B		P
7440-48-4	Cobalt	326			P
7440-50-8	Copper	1770		*J	P
7439-89-6	Iron	1490000			P
7439-92-1	Lead	783		EJ	P
7439-95-4	Magnesium	95500			P
7439-96-5	Manganese	147000			P
7439-97-6	Mercury	0.10	U	NJ	CV
7440-02-0	Nickel	306			P
7440-09-7	Potassium	861	B	EJ	P
7782-49-2	Selenium	17.7		NJ	P
7440-22-4	Silver	50.8		J	P
7440-23-5	Sodium	40000		J	P
7440-28-0	Thallium	44.8			P
7440-62-2	Vanadium	1.4	U	J	P
7440-66-6	Zinc	898000			P
	Cyanide				NR

02/04/99

Color Before: COLORLESS

Clarity Before: CLEAR

Texture:

Color After: COLORLESS

Clarity After: CLEAR

Artifacts:

Comments:

INORGANIC ANALYSIS DATA SHEET

EPA SAMPLE NO.

MJAF27

Lab Name: SENTINEL, INC.

Contract: 68-D6-0001

Lab Code: SENTIN

Case No.: 26799

SAS No.:

SDG No.: MJAF24

Matrix (soil/water): WATER

Lab Sample ID: 18146S

Level (low/med): LOW

Date Received: 02/11/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	593			P
7440-36-0	Antimony	3.5	U	NJ	P
7440-38-2	Arsenic	24.7			P
7440-39-3	Barium	5.7	B	EJ	P
7440-41-7	Beryllium	0.42	B		P
7440-43-9	Cadmium	0.53	B	U	P
7440-70-2	Calcium	3430	B		P
7440-47-3	Chromium	1.3	B		P
7440-48-4	Cobalt	7.6	B		P
7440-50-8	Copper	237		*J	P
7439-89-6	Iron	14200			P
7439-92-1	Lead	46.3		EJ	P
7439-95-4	Magnesium	1390	B		P
7439-96-5	Manganese	1590			P
7439-97-6	Mercury	0.10	U	NJ	CV
7440-02-0	Nickel	5.6	B		P
7440-09-7	Potassium	724	B	EJ	P
7782-49-2	Selenium	3.1	U	NJ	P
7440-22-4	Silver	1.2	B		P
7440-23-5	Sodium	639	B		P
7440-28-0	Thallium	4.9	U		P
7440-62-2	Vanadium	1.4	U		P
7440-66-6	Zinc	592			P
	Cyanide				NR

ALL 4/6/99

Color Before: COLORLESS

Clarity Before: CLEAR

Texture:

Color After: COLORLESS

Clarity After: CLEAR

Artifacts:

Comments:

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAF28

Lab Name: SENTINEL, INC.

Contract: 68-D6-0001

Lab Code: SENTIN

Case No.: 26799

SAS No.:

SDG No.: MJAF24

Matrix (soil/water): WATER

Lab Sample ID: 18147S

Level (low/med): LOW

Date Received: 02/11/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	205		UJ	P
7440-36-0	Antimony	3.5	U	NJ	P
7440-38-2	Arsenic	3.7	U		P
7440-39-3	Barium	21.4	B	EJ	P
7440-41-7	Beryllium	0.30	U		P
7440-43-9	Cadmium	12.0			P
7440-70-2	Calcium	372000			P
7440-47-3	Chromium	2.4	B		P
7440-48-4	Cobalt	259			P
7440-50-8	Copper	141		*J	P
7439-89-6	Iron	131000			P
7439-92-1	Lead	681		EJ	P
7439-95-4	Magnesium	414000			P
7439-96-5	Manganese	327000			P
7439-97-6	Mercury	0.10	U	NJ	CV
7440-02-0	Nickel	238			P
7440-09-7	Potassium	17700		EJ	P
7782-49-2	Selenium	67.9		NJ	P
7440-22-4	Silver	75.3			P
7440-23-5	Sodium	3960	B		P
7440-28-0	Thallium	146			P
7440-62-2	Vanadium	1.4	U	J	P
7440-66-6	Zinc	34900			P
	Cyanide				NR

Dec 24/09/99

Color Before: COLORLESS

Clarity Before: CLEAR

Texture:

Color After: COLORLESS

Clarity After: CLEAR

Artifacts:

Comments:

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAF29

Lab Name: SENTINEL, INC.

Contract: 68-D6-0001

Lab Code: SENTIN

Case No.: 26799

SAS No.:

SDG No.: MJAF24

Matrix (soil/water): WATER

Lab Sample ID: 18148S

Level (low/med): LOW

Date Received: 02/11/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	2140	-	J	P
7440-36-0	Antimony	3.5	U	NJ	P
7440-38-2	Arsenic	50.8			P
7440-39-3	Barium	32.3	B	EJ	P
7440-41-7	Beryllium	0.76	B		P
7440-43-9	Cadmium	144			P
7440-70-2	Calcium	197000			P
7440-47-3	Chromium	2.9	B		P
7440-48-4	Cobalt	172			P
7440-50-8	Copper	119		*J	P
7439-89-6	Iron	128000			P
7439-92-1	Lead	544		EJ	P
7439-95-4	Magnesium	233000			P
7439-96-5	Manganese	177000			P
7439-97-6	Mercury	0.10	U	NJ	CV
7440-02-0	Nickel	161			P
7440-09-7	Potassium	8950		EJ	P
7782-49-2	Selenium	28.2		NJ	P
7440-22-4	Silver	42.3			P
7440-23-5	Sodium	2630	B		P
7440-28-0	Thallium	63.4			P
7440-62-2	Vanadium	1.4	U	J	P
7440-66-6	Zinc	86200			P
	Cyanide				NR

See 04/11/99

Color Before: COLORLESS

Clarity Before: CLEAR

Texture:

Color After: COLORLESS

Clarity After: CLEAR

Artifacts:

Comments:

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAF30

Lab Name: SENTINEL, INC.

Contract: 68-D6-0001

Lab Code: SENTIN

Case No.: 26799

SAS No.:

SDG No.: MJAF24

Matrix (soil/water): WATER

Lab Sample ID: 18149S

Level (low/med): LOW

Date Received: 02/11/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	100	B	US	P
7440-36-0	Antimony	3.5	U	NJ	P
7440-38-2	Arsenic	3.7	U		P
7440-39-3	Barium	113	B	EJ	P
7440-41-7	Beryllium	0.34	B		P
7440-43-9	Cadmium	16.9			P
7440-70-2	Calcium	20200			P
7440-47-3	Chromium	1.7	B		P
7440-48-4	Cobalt	16.1	B		P
7440-50-8	Copper	14.7	B	*US	P
7439-89-6	Iron	3880			P
7439-92-1	Lead	550		EJ	P
7439-95-4	Magnesium	40400			P
7439-96-5	Manganese	12600			P
7439-97-6	Mercury	0.10	U	NJ	CV
7440-02-0	Nickel	20.3	B		P
7440-09-7	Potassium	1270	B	EJ	P
7782-49-2	Selenium	3.1	U	NJ	P
7440-22-4	Silver	4.1	B		P
7440-23-5	Sodium	1310	B		P
7440-28-0	Thallium	4.9	U		P
7440-62-2	Vanadium	1.4	U		P
7440-66-6	Zinc	4570			P
	Cyanide				NR

AK 4/07/99

Color Before: COLORLESS

Clarity Before: CLEAR

Texture:

Color After: COLORLESS

Clarity After: CLEAR

Artifacts:

Comments:

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAF31

Lab Name: SENTINEL, INC.

Contract: 68-D6-0001

Lab Code: SENTIN

Case No.: 26799

SAS No.:

SDG No.: MJAF24

Matrix (soil/water): WATER

Lab Sample ID: 18150S

Level (low/med): LOW

Date Received: 02/11/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	1520	-	J	P
7440-36-0	Antimony	3.5	U	NJ	P
7440-38-2	Arsenic	31.1			P
7440-39-3	Barium	19.7	B	EJ	P
7440-41-7	Beryllium	0.97	B		P
7440-43-9	Cadmium	173			P
7440-70-2	Calcium	16300		J	P
7440-47-3	Chromium	2.4	B		P
7440-48-4	Cobalt	25.6	B		P
7440-50-8	Copper	75.0		*J	P
7439-89-6	Iron	71700			P
7439-92-1	Lead	556		EJ	P
7439-95-4	Magnesium	31300			P
7439-96-5	Manganese	24700			P
7439-97-6	Mercury	0.10	U	NJ	CV
7440-02-0	Nickel	30.4	B		P
7440-09-7	Potassium	870	B	EJ	P
7782-49-2	Selenium	3.8	B	NJ	P
7440-22-4	Silver	8.0	B		P
7440-23-5	Sodium	701	B		P
7440-28-0	Thallium	4.9	U		P
7440-62-2	Vanadium	1.4	U		P
7440-66-6	Zinc	69700			P
	Cyanide				NR

Color Before: COLORLESS

Clarity Before: CLEAR

Texture:

Color After: COLORLESS

Clarity After: CLEAR

Artifacts:

Comments:

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAF32

Lab Name: SENTINEL, INC.

Contract: 68-D6-0001

Lab Code: SENTIN

Case No.: 26799

SAS No.:

SDG No.: MJAF24

Matrix (soil/water): WATER

Lab Sample ID: 18151S

Level (low/med): LOW

Date Received: 02/11/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	12.8	U	J	P
7440-36-0	Antimony	3.5	U	NJ	P
7440-38-2	Arsenic	3.7	U		P
7440-39-3	Barium	1.5	U	EJ	P
7440-41-7	Beryllium	0.30	U		P
7440-43-9	Cadmium	0.30	U		P
7440-70-2	Calcium	95.8	B	U	P
7440-47-3	Chromium	0.70	U		P
7440-48-4	Cobalt	1.6	U		P
7440-50-8	Copper	55.6		*J	P
7439-89-6	Iron	33.3	B	U	P
7439-92-1	Lead	2.8	B	EJ	P
7439-95-4	Magnesium	23.8	B	U	P
7439-96-5	Manganese	24.1		U	P
7439-97-6	Mercury	0.10	U	NJ	CV
7440-02-0	Nickel	3.1	U		P
7440-09-7	Potassium	18.6	B	EJ	P
7782-49-2	Selenium	3.1	U	NJ	P
7440-22-4	Silver	0.70	U		P
7440-23-5	Sodium	106	U		P
7440-28-0	Thallium	4.9	U		P
7440-62-2	Vanadium	1.4	U		P
7440-66-6	Zinc	75.5		U	P
	Cyanide				NR

JL 2/11/99

Color Before: COLORLESS

Clarity Before: CLEAR

Texture:

Color After: COLORLESS

Clarity After: CLEAR

Artifacts:

Comments:

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAF33

Lab Name: SENTINEL, INC.

Contract: 68-D6-0001

Lab Code: SENTIN

Case No.: 26799

SAS No.:

SDG No.: MJAF24

Matrix (soil/water): WATER

Lab Sample ID: 18152S

Level (low/med): LOW

Date Received: 02/11/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	104000	-	J	P
7440-36-0	Antimony	92.3		NJ	P
7440-38-2	Arsenic	3690		J	P
7440-39-3	Barium	10.7	B	EJ	P
7440-41-7	Beryllium	21.5		J	P
7440-43-9	Cadmium	5750		J	P
7440-70-2	Calcium	128000		J	P
7440-47-3	Chromium	8.6	B		P
7440-48-4	Cobalt	1770		J	P
7440-50-8	Copper	4790		*J	P
7439-89-6	Iron	4390000			P
7439-92-1	Lead	316		EJ	P
7439-95-4	Magnesium	316000		J	P
7439-96-5	Manganese	659000			P
7439-97-6	Mercury	0.10	U	NJ	CV
7440-02-0	Nickel	1540		J	P
7440-09-7	Potassium	559	B	EJ	P
7782-49-2	Selenium	3.1	U	NJ	P
7440-22-4	Silver	54.0		J	P
7440-23-5	Sodium	205000		J	P
7440-28-0	Thallium	186			P
7440-62-2	Vanadium	1.4	U	J	P
7440-66-6	Zinc	4990000			P
	Cyanide				NR

11/04/09/99

Color Before: COLORLESS

Clarity Before: CLEAR

Texture:

Color After: COLORLESS

Clarity After: CLEAR

Artifacts:

Comments:

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAF34

Lab Name: SENTINEL, INC.

Contract: 68-D6-0001

Lab Code: SENTIN

Case No.: 26799

SAS No.:

SDG No.: MJAF24

Matrix (soil/water): WATER

Lab Sample ID: 18153S

Level (low/med): LOW

Date Received: 02/11/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	7410	-		P
7440-36-0	Antimony	3.5	U	NJ	P
7440-38-2	Arsenic	157			P
7440-39-3	Barium	21.2	B	EJ	P
7440-41-7	Beryllium	3.1	B		P
7440-43-9	Cadmium	510			P
7440-70-2	Calcium	36200		J	P
7440-47-3	Chromium	1.1	B		P
7440-48-4	Cobalt	148			P
7440-50-8	Copper	408		*J	P
7439-89-6	Iron	256000			P
7439-92-1	Lead	343		EJ	P
7439-95-4	Magnesium	74300			P
7439-96-5	Manganese	66300			P
7439-97-6	Mercury	0.10	U	NJ	CV
7440-02-0	Nickel	134			P
7440-09-7	Potassium	1180	B	EJ	P
7782-49-2	Selenium	8.2		NJ	P
7440-22-4	Silver	18.9			P
7440-23-5	Sodium	4880	B		P
7440-28-0	Thallium	15.6			P
7440-62-2	Vanadium	1.4	U	J	P
7440-66-6	Zinc	264000			P
	Cyanide				NR

JL 04/07/99

Color Before: COLORLESS

Clarity Before: CLEAR

Texture:

Color After: COLORLESS

Clarity After: CLEAR

Artifacts:

Comments:

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAF35

Lab Name: SENTINEL, INC.

Contract: 68-D6-0001

Lab Code: SENTIN

Case No.: 26799

SAS No.:

SDG No.: MJAF24

Matrix (soil/water): WATER

Lab Sample ID: 18154S

Level (low/med): LOW

Date Received: 02/11/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	174000		J	P
7440-36-0	Antimony	159		N J	P
7440-38-2	Arsenic	5680		J	P
7440-39-3	Barium	16.8	B	E UJ	P
7440-41-7	Beryllium	32.4		J	P
7440-43-9	Cadmium	7680		J	P
7440-70-2	Calcium	138000		J	P
7440-47-3	Chromium	18.5			P
7440-48-4	Cobalt	2390		J	P
7440-50-8	Copper	8460		N J	P
7439-89-6	Iron	13200000			P
7439-92-1	Lead	124		E J	P
7439-95-4	Magnesium	377000		J	P
7439-96-5	Manganese	29600		J	P
7439-97-6	Mercury	0.10	U	N J	CV
7440-02-0	Nickel	2010		J	P
7440-09-7	Potassium	155	B	E UJ	P
7782-49-2	Selenium	3.1	U	N J	P
7440-22-4	Silver	0.70	U	J	P
7440-23-5	Sodium	344000		J	P
7440-28-0	Thallium	173			P
7440-62-2	Vanadium	1.4	U	J	P
7440-66-6	Zinc	19100000			P
	Cyanide				NR

02/04/02/99

Color Before: COLORLESS

Clarity Before: CLEAR

Texture:

Color After: COLORLESS

Clarity After: CLEAR

Artifacts:

Comments:

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAF36

Lab Name: SENTINEL, INC.

Contract: 68-D6-0001

Lab Code: SENTIN

Case No.: 26799

SAS No.:

SDG No.: MJAF24

Matrix (soil/water): WATER

Lab Sample ID: 18155S

Level (low/med): LOW

Date Received: 02/11/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	21200	-		P
7440-36-0	Antimony	26.2	B	NJ	P
7440-38-2	Arsenic	820			P
7440-39-3	Barium	9.8	B	EUJ	P
7440-41-7	Beryllium	8.3			P
7440-43-9	Cadmium	2130			P
7440-70-2	Calcium	49500			P
7440-47-3	Chromium	3.7	B		P
7440-48-4	Cobalt	333			P
7440-50-8	Copper	1720		*J	P
7439-89-6	Iron	1520000			P
7439-92-1	Lead	798		EJ	P
7439-95-4	Magnesium	97800			P
7439-96-5	Manganese	149000			P
7439-97-6	Mercury	0.10	U	NJ	CV
7440-02-0	Nickel	317		J	P
7440-09-7	Potassium	862	B	EUJ	P
7782-49-2	Selenium	21.7		NJ	P
7440-22-4	Silver	51.5		J	P
7440-23-5	Sodium	43300		J	P
7440-28-0	Thallium	46.9			P
7440-62-2	Vanadium	1.4	U	J	P
7440-66-6	Zinc	913000			P
	Cyanide				NR

Color Before: COLORLESS

Clarity Before: CLEAR

Texture:

Color After: COLORLESS

Clarity After: CLEAR

Artifacts:

Comments:

INORGANIC ANALYSIS DATA SHEET

EPA SAMPLE NO.

MJAF37

Lab Name: SENTINEL, INC.

Contract: 68-D6-0001

Lab Code: SENTIN

Case No.: 26799

SAS No.:

SDG No.: MJAF24

Matrix (soil/water): WATER

Lab Sample ID: 18156S

Level (low/med): LOW

Date Received: 02/11/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	585			P
7440-36-0	Antimony	3.5	U	NJ	P
7440-38-2	Arsenic	11.3			P
7440-39-3	Barium	12.2	B	EJ	P
7440-41-7	Beryllium	0.33	B		P
7440-43-9	Cadmium	2.3	B		P
7440-70-2	Calcium	3610	B		P
7440-47-3	Chromium	0.70	U		P
7440-48-4	Cobalt	7.8	B		P
7440-50-8	Copper	61.5		*J	P
7439-89-6	Iron	13800			P
7439-92-1	Lead	26.3		EJ	P
7439-95-4	Magnesium	1590	B		P
7439-96-5	Manganese	1820			P
7439-97-6	Mercury	0.10	U	NJ	CV
7440-02-0	Nickel	5.2	B		P
7440-09-7	Potassium	770	B	EJ	P
7782-49-2	Selenium	3.1	U	NJ	P
7440-22-4	Silver	0.70	U		P
7440-23-5	Sodium	838	B	U	P
7440-28-0	Thallium	4.9	U		P
7440-62-2	Vanadium	1.4	U		P
7440-66-6	Zinc	1320			P
	Cyanide				NR

Color Before: COLORLESS

Clarity Before: CLEAR

Texture:

Color After: COLORLESS

Clarity After: CLEAR

Artifacts:

Comments:

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAF38

Lab Name: SENTINEL, INC.

Contract: 68-D6-0001

Lab Code: SENTIN

Case No.: 26799

SAS No.:

SDG No.: MJAF24

Matrix (soil/water): WATER

Lab Sample ID: 18157S

Level (low/med): LOW

Date Received: 02/11/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	64.0	B	UJ	P
7440-36-0	Antimony	3.5	U	NJ	P
7440-38-2	Arsenic	3.7	U		P
7440-39-3	Barium	24.1	B	EJ	P
7440-41-7	Beryllium	0.30	U		P
7440-43-9	Cadmium	13.7			P
7440-70-2	Calcium	349000			P
7440-47-3	Chromium	2.8	B		P
7440-48-4	Cobalt	251			P
7440-50-8	Copper	5.0	B	* UJ	P
7439-89-6	Iron	123000			P
7439-92-1	Lead	494		EJ	P
7439-95-4	Magnesium	400000			P
7439-96-5	Manganese	303000			P
7439-97-6	Mercury	0.10	U	NJ	CV
7440-02-0	Nickel	233			P
7440-09-7	Potassium	17300		EJ	P
7782-49-2	Selenium	62.5		NJ	P
7440-22-4	Silver	72.8			P
7440-23-5	Sodium	3970	B		P
7440-28-0	Thallium	129			P
7440-62-2	Vanadium	1.4	U	J	P
7440-66-6	Zinc	33100			P
	Cyanide				NR

1/24/99

Color Before: COLORLESS

Clarity Before: CLEAR

Texture:

Color After: COLORLESS

Clarity After: CLEAR

Artifacts:

Comments:

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EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAF39

Lab Name: SENTINEL, INC.

Contract: 68-D6-0001

Lab Code: SENTIN

Case No.: 26799

SAS No.:

SDG No.: MJAF24

Matrix (soil/water): WATER

Lab Sample ID: 18158S

Level (low/med): LOW

Date Received: 02/11/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	2040	-	J	P
7440-36-0	Antimony	3.5	U	NJ	P
7440-38-2	Arsenic	3.7	U		P
7440-39-3	Barium	38.3	B	EJ	P
7440-41-7	Beryllium	0.86	B		P
7440-43-9	Cadmium	142			P
7440-70-2	Calcium	189000			P
7440-47-3	Chromium	3.0	B		P
7440-48-4	Cobalt	168			P
7440-50-8	Copper	124		*J	P
7439-89-6	Iron	79000			P
7439-92-1	Lead	492		EJ	P
7439-95-4	Magnesium	227000			P
7439-96-5	Manganese	190000			P
7439-97-6	Mercury	0.10	U	NJ	CV
7440-02-0	Nickel	158			P
7440-09-7	Potassium	8590		EJ	P
7782-49-2	Selenium	28.9		NJ	P
7440-22-4	Silver	40.8			P
7440-23-5	Sodium	2940	B		P
7440-28-0	Thallium	60.7			P
7440-62-2	Vanadium	1.4	U		P
7440-66-6	Zinc	92800			P
	Cyanide				NR

M 04/11/99

Color Before: COLORLESS

Clarity Before: CLEAR

Texture:

Color After: COLORLESS

Clarity After: CLEAR

Artifacts:

Comments:

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAF40

Lab Name: SENTINEL, INC.

Contract: 68-D6-0001

Lab Code: SENTIN

Case No.: 26799

SAS No.:

SDG No.: MJAF24

Matrix (soil/water): WATER

Lab Sample ID: 18159S

Level (low/med): LOW

Date Received: 02/11/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	37.1	B	UJ	P
7440-36-0	Antimony	3.5	U	NJ	P
7440-38-2	Arsenic	3.7	U		P
7440-39-3	Barium	112	B	EJ	P
7440-41-7	Beryllium	0.30	U		P
7440-43-9	Cadmium	14.7			P
7440-70-2	Calcium	19900			P
7440-47-3	Chromium	0.70	U		P
7440-48-4	Cobalt	14.8	B		P
7440-50-8	Copper	20.1	B	*UJ	P
7439-89-6	Iron	1950			P
7439-92-1	Lead	135		EJ	P
7439-95-4	Magnesium	39700			P
7439-96-5	Manganese	12400			P
7439-97-6	Mercury	0.10	U	NJ	CV
7440-02-0	Nickel	19.3	B		P
7440-09-7	Potassium	1220	B	EJ	P
7782-49-2	Selenium	3.5	B	NJ	P
7440-22-4	Silver	3.0	B		P
7440-23-5	Sodium	1250	B		P
7440-28-0	Thallium	5.2	B		P
7440-62-2	Vanadium	1.4	U		P
7440-66-6	Zinc	3470			P
	Cyanide				NR

Color Before: COLORLESS

Clarity Before: CLEAR

Texture:

Color After: COLORLESS

Clarity After: CLEAR

Artifacts:

Comments:

INORGANIC ANALYSIS DATA SHEET

EPA SAMPLE NO.

MJAF41

Lab Name: SENTINEL, INC.

Contract: 68-D6-0001

Lab Code: SENTIN

Case No.: 26799

SAS No.:

SDG No.: MJAF24

Matrix (soil/water): WATER

Lab Sample ID: 18160S

Level (low/med): LOW

Date Received: 02/11/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	1630			P
7440-36-0	Antimony	3.5	U	NJ	P
7440-38-2	Arsenic	22.4			P
7440-39-3	Barium	27.5	B	EJ	P
7440-41-7	Beryllium	0.99	B		P
7440-43-9	Cadmium	174			P
7440-70-2	Calcium	16500		J	P
7440-47-3	Chromium	0.99	B		P
7440-48-4	Cobalt	25.5	B		P
7440-50-8	Copper	125		*J	P
7439-89-6	Iron	71300			P
7439-92-1	Lead	561		EJ	P
7439-95-4	Magnesium	31800			P
7439-96-5	Manganese	25000			P
7439-97-6	Mercury	0.10	U	NJ	CV
7440-02-0	Nickel	32.2	B		P
7440-09-7	Potassium	950	B	EJ	P
7782-49-2	Selenium	3.1	U	NJ	P
7440-22-4	Silver	8.6	B		P
7440-23-5	Sodium	685	B		P
7440-28-0	Thallium	5.9	B		P
7440-62-2	Vanadium	1.4	U		P
7440-66-6	Zinc	70300			P
	Cyanide				NR

Color Before: COLORLESS

Clarity Before: CLEAR

Texture:

Color After: COLORLESS

Clarity After: CLEAR

Artifacts:

Comments:

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAF42

Lab Name: SENTINEL, INC.

Contract: 68-D6-0001

Lab Code: SENTIN

Case No.: 26799

SAS No.:

SDG No.: MJAF24

Matrix (soil/water): WATER

Lab Sample ID: 18161S

Level (low/med): LOW

Date Received: 02/11/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	12.8	U		P
7440-36-0	Antimony	3.5	U	NJ	P
7440-38-2	Arsenic	3.7	U		P
7440-39-3	Barium	1.5	U	EJ	P
7440-41-7	Beryllium	0.30	U		P
7440-43-9	Cadmium	0.30	U		P
7440-70-2	Calcium	108	B	U	P
7440-47-3	Chromium	0.70	U		P
7440-48-4	Cobalt	1.6	U		P
7440-50-8	Copper	17.2	B	*UJ	P
7439-89-6	Iron	12.7	B	U	P
7439-92-1	Lead	3.6		EJ	P
7439-95-4	Magnesium	14.5	U		P
7439-96-5	Manganese	2.3	B	U	P
7439-97-6	Mercury	0.10	U	NJ	CV
7440-02-0	Nickel	3.1	U		P
7440-09-7	Potassium	58.8	B	E UJ	P
7782-49-2	Selenium	3.1	U	NJ	P
7440-22-4	Silver	0.98	B		P
7440-23-5	Sodium	240	B		P
7440-28-0	Thallium	4.9	U		P
7440-62-2	Vanadium	1.4	U		P
7440-66-6	Zinc	28.5		U	P
	Cyanide				NR

MA 04/09/99

Color Before: COLORLESS

Clarity Before: CLEAR

Texture:

Color After: COLORLESS

Clarity After: CLEAR

Artifacts:

Comments:

EPA SAMPLE NO.

INORGANIC ANALYSIS DATA SHEET

MJAF43

Lab Name: SENTINEL, INC.

Contract: 68-D6-0001

Lab Code: SENTIN

Case No.: 26799

SAS No.:

SDG No.: MJAF24

Matrix (soil/water): WATER

Lab Sample ID: 18162S

Level (low/med): LOW

Date Received: 02/11/99

% Solids: 0.0

Concentration Units (ug/L or mg/Kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	88500		J	P
7440-36-0	Antimony	76.2		NJ	P
7440-38-2	Arsenic	3140		J	P
7440-39-3	Barium	14.4	B	EJ	P
7440-41-7	Beryllium	17.7		J	P
7440-43-9	Cadmium	4930		J	P
7440-70-2	Calcium	120000		J	P
7440-47-3	Chromium	5.3	B		P
7440-48-4	Cobalt	1530		J	P
7440-50-8	Copper	4200		*J	P
7439-89-6	Iron	3590000			P
7439-92-1	Lead	358		EJ	P
7439-95-4	Magnesium	277000		J	P
7439-96-5	Manganese	551000			P
7439-97-6	Mercury	0.10	U	NJ	CV
7440-02-0	Nickel	1330		J	P
7440-09-7	Potassium	648	B	EJ	P
7782-49-2	Selenium	9.2		NJ	P
7440-22-4	Silver	66.9		J	P
7440-23-5	Sodium	163000		J	P
7440-28-0	Thallium	161			P
7440-62-2	Vanadium	1.4	U	J	P
7440-66-6	Zinc	3690000			P
	Cyanide				NR

Color Before: COLORLESS

Clarity Before: CLEAR

Texture:

Color After: COLORLESS

Clarity After: CLEAR

Artifacts:

Comments: